

GDS was a Wellcome fellow in clinical epidemiology when the fieldwork for this study was completed.

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## Bed sharing and the sudden infant death syndrome

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### Abstract

**Objective**—To determine whether infants who died of the sudden infant death syndrome routinely shared their parents' bed more commonly than control infants.

**Design**—Case-control study.

**Setting**—Southern California.

**Subjects**—200 white, African-American, Latin American, and Asian infants who died and 200 living controls, matched by birth hospital, date of birth, sex, and race.

**Main outcome measures**—Routine bedding (for example, crib, cradle), day and night time sleeping arrangement (for example, alone or sharing a bed); for cases only, sleeping arrangement at death. Differences in bed sharing practices among races.

**Results**—Of the infants who died of the syndrome, 45 (22.4%) were sharing a bed. Daytime bed sharing was more common in African-American ( $P < 0.001$ ) and Latin American families ( $P < 0.001$ ) than in white families. The overall adjusted odds ratio for the syndrome and routine bed sharing in the daytime was 1.38 (95% confidence interval 0.59 to 3.22) and for night was 1.21 (0.59 to 2.48). These odds ratios were adjusted for routine sleep position, passive smoking, breast feeding, intercom use, infant birth weight, medical conditions at birth, and maternal age and education. There was no interaction between bed sharing and passive smoking or alcohol use by either parent.

**Conclusions**—Although there was a significant difference between bed sharing among African-American and Latin American parents compared with white parents, there was no significant relation between routine bed sharing and the sudden infant death syndrome.

### Introduction

Reasons for bed sharing emerge from evolutionary, developmental, and cross cultural perspectives.<sup>1</sup> Parental sleep contact promotes sleep, breathing, and arousal patterns in infants,<sup>1</sup> and parents and infants who sleep together exhibit synchronous arousals<sup>1,2</sup> and coordination of sleep stages.<sup>2,3</sup> The composition of human milk also supports bed sharing; its low energy value causes infants to feed on demand throughout the day and night.<sup>2</sup>

Despite its reported benefits, bed sharing has also been linked to an increased risk of the sudden infant death syndrome. Mitchell *et al* ascribed such deaths to sleeping with adults, which may overheat infants.<sup>4</sup> A case-control study in England found that bed sharing was more common in cases than controls.<sup>5</sup> A nationwide case-control study in New Zealand found a twofold increase in the risk of the sudden infant death syndrome associated with sharing a bed<sup>6</sup>; further analyses by Scragg *et al*, however, found that bed sharing before death was a risk factor only among Maori infants.<sup>7</sup> There was an interaction between bed sharing and maternal smoking on an additive scale (odds ratio=5.94). A postal survey of 197 infants in southern Australia suggested that a parent's alcohol consumption the night before the death may be a cofactor with bed sharing.<sup>8</sup> A study of 92 cases and 100 controls in the District of Columbia found a threefold excess rate over the general population for bed sharing and the risk of the sudden infant death syndrome.<sup>9</sup> The authors surmised this was due to asphyxia from overlaying, possibly combined with parental consumption of alcohol or drugs.<sup>9</sup> A survey of Asian and white mothers by Farouqui *et al* did not support the hypothesis that bed sharing increased the risk of the sudden infant death syndrome.<sup>10</sup> Asian infants were more

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likely to share the parents' bed but less inclined to be exposed to passive smoke than white infants. Nevertheless, white infants had twice the mortality from the sudden infant death syndrome, compared with Asian infants. To our knowledge, there are no other studies investigating bed sharing and the sudden infant death syndrome.

It is difficult to conclude that sharing a bed is dangerous across all cultures. The lowest rates of the syndrome occur in Asia, especially Japan, where sharing a bed is common.<sup>11</sup> In New Zealand, however, where bed sharing occurred on sheepskin bedding or in the presence of maternal smoking, rates were extremely high before the introduction of the "lower risk" campaign.

We examined the relation between routine bed sharing and bed sharing at the time of death and the sudden infant death syndrome in a case-control study of 200 case and 200 control white, Latin American, Asian (Chinese, Filipino, Vietnamese, Japanese, Korean, Samoan, Burmese, Guamanian, Hawaiian) and Pacific Islander, and African-American infants in southern California.

## Methods

Cases attributed to the syndrome were obtained from death certificates from five health departments in southern California (San Diego, San Bernardino, Riverside, Orange, and Los Angeles counties). All case infants had undergone necropsy at death between January 1989 and December 1992. Parents of infants whose death was attributed to the syndrome were contacted by post for participation in the study six to 12 months after the death, the grief period required by the Human Subjects Committee.

Control infants were randomly selected (by using a random number table and identification numbers) from all eligible live born infants in 110 southern California hospitals. Each control infant had the same birth hospital, date of birth, sex, and race as the matched case infant. Directors of medical records departments initially contacted prospective control parents by post. Control parents were contacted about three to six months after the case interview. A history of infant care practices (for example, routine sleep position, illnesses, vaccinations, and breast feeding) was obtained when the control baby was the same age as the index case.

Infants with respiratory problems, fetal distress, metabolic disturbances, and morphological abnormalities were not included in the study. Multiple births, infants over 1 year of age, adopted babies, and cases in which necropsy was not undertaken were excluded from the study.

Parents of infants who died and control parents provided written informed consent for the interview and access to obstetric and paediatric records. Parents then participated in a 45 to 60 minute standardised telephone interview, which provided demographic information, obstetric history, information on labour and delivery, neonatal characteristics, parental lifestyle, family history of diseases, and circumstances of death for cases. Parents also reported routine place of sleeping for the infant—specifically, a crib, carrycot, pram, cradle, swing, parents' or other person's bed, couch, floor, or other place—for both day and night. The infant's sleeping arrangement was noted, specifically if he or she slept in the same room as a parent or alone in another room. Bed sharing was defined as routinely sharing a bed with a specified person, including the mother, father, other relative (sibling, aunt, grandparent, etc), or babysitter during the day or night. Infants who had a combination of bed sharing and sleeping alone were separately noted.

Routine sleep position was classified as on the stomach, back, or side; alternating between any two positions; or no usual position. Regular use of an intercom was reported. Feeding history included exclusive breast feeding, formula milk, or both breast and formula milk, and the frequency of feeding each day from birth. Passive smoking was based on cigarette smoking by the mother, father, live in adult, or daycare provider. The infant's birth weight and any medical condition at birth were recorded (for example, jaundice, apnoea, fever, aspiration of meconium).

The infant's race was categorised on the basis of both parents' races. Babies with both parents of the same race were assigned that race. When one parent was white and the other parent was Asian, Latin American, or African-American the baby was assigned the race of the minority parent, in accordance with the guidelines from the United States government on vital statistics.<sup>12</sup> If both parents were different minority races, the baby was assigned the race with the smallest representation in California.

## STATISTICAL ANALYSES

Preliminary analysis was based on the first 200 case and 200 matched control parents interviewed before the height of publicity in the United States about sleep position. Three hundred cases and 300 controls were interviewed for this study, out of a total of 400 case and 400 control parents. About 2% of parents of children who died and 1.3% of control parents refused to participate.

Conditional logistic regression was used to estimate independently the odds ratio of the syndrome associated with bed sharing in the day and night with simultaneous adjustment for potential confounders. Stratified analysis and published data were the criteria used for adding variables to the logistic regression model. Descriptive analyses were computed by using the statistical software package SAS<sup>13</sup>; multivariate analyses used EGRET.<sup>14</sup>

## Results

Parents of infants who died were about three years younger than parents of healthy babies (26 years and 28 years for case mothers and fathers, respectively;  $P < 0.001$ ), and education levels for fathers of infants who died were slightly lower than for control fathers (12.5 *v* 13.4 years;  $P < 0.01$ ). More parents of healthy infants were married or living together than parents of infants who died (77% *v* 63%, respectively;  $P < 0.01$ ). The total racial distribution of babies in the two groups was approximately 48% (192) white, 30% (120) Latin American, 11% (44) Asian and Pacific Islander, 10% (40) African-American, and 1% (4) North American Indian. All mothers had their pregnancies confirmed during the seventh week of gestation. There was no significant difference between the proportion of the mothers in each group who received prenatal care (175 (cases) *v* 185 (controls)). Infants who died had significantly lower birth weights than control infants (3236 g *v* 3459 g;  $P < 0.001$ ).

There was no difference in age (categorised as  $\leq 20$  years and  $> 20$  years) between case or control mothers who chose for their infant to share a bed and those whose infants slept alone. Mothers who slept with their infants, however, were less educated ( $\leq 12$  years in total) than mothers whose infants slept alone ( $P = 0.02$  for cases;  $P < 0.01$  for controls).

Routine bed sharing was assessed independently for day and night. Daytime bed sharing was most common in African-American and Latin American families compared with white households. African-American controls and Asian cases were more likely than white infants to share a bed at night (table I).

TABLE I—Number (percentage) by racial category of 200 children who died from the sudden infant death syndrome and 200 controls routinely sharing a bed with adult in day or night: southern California, 1989-92

Race	Cases				Controls			
	Day		Night		Day		Night	
	No	(%)	No	(%)	No	(%)	No	(%)
White	10	(10.4)	20	(20.8)	9	(9.5)	14	(14.7)
African-American	11	(57.9)***	9	(47.4)*	8	(40)***	11	(55)***
Latin American	22	(39.3)**	24	(42.9)***	18	(29.5)***	25	(41)***
Asian	6	(26.1)*	7	(30.4)	1	(5.3)	2	(10.5)
Native American	1	(50)	0		0		0	

\*P < 0.05; \*\*P < 0.01; \*\*\*P ≤ 0.001.

TABLE II—Sleep location at time of death in 200 cases of the sudden infant death syndrome, southern California, 1989-92

Location	No of children
Crib	81
Pram	41
Sharing parents' bed	35
Cradle	8
Couch	7
Babysitter's bed	6
Mother's arms	4
Swing	4
Floor	4
Playpen	3
Folding bed	1
Wool mat	1
Cushion or pillow	1
Baby carrier	1
Waterbed	1
Unknown	2

Fifty of the infants who died and 36 controls routinely shared a bed during the daytime (P=0.11), whereas in the night bed sharing occurred in 60 cases and 52 controls (P=0.36) (table II).

At death, 45 infants were sharing a bed with a parent (35 sleeping together, four sleeping in mother's arms) or babysitter (six) (table I); the remainder were reported as sleeping alone.

Case infants who shared a bed with a parent were more likely to have been exposed to passive smoke than infants who slept alone during the day and night. Control infants who vomited after feeds were less likely to share a bed (P=0.028). Parents in both groups who had shared with their infant were less likely to use an intercom (P=0.012 for cases in daytime and night; P<0.01 for controls for daytime only).

The relation between bed sharing and the syndrome did not differ by race; in fact the odds ratio for night was higher in whites than non-whites (1.52 v 1.12) whereas for daytime it was reversed (1.11 for whites and 1.78 for non-whites), indicating no consistent pattern. Case and control babies who routinely shared a bed did not significantly differ by sleep position, breast feeding, use of pacifiers, ease of waking from sleep, or irregular breathing. Bed sharing did not vary by season. During the day low birthweight case infants who later died were more likely to share a bed (P=0.014).

The unadjusted odds ratio for the syndrome and bed sharing for daytime was 1.52 (95% confidence interval 0.92 to 2.52); for night it was 1.28 (0.81 to 2.03). The overall adjusted odds ratio was 1.38 (0.59 to 3.22) for routine bed sharing during the day, and 1.21 (0.59 to 2.48) for routine bed sharing during the night after adjustment for routine sleep position, birth weight, medical conditions at birth, passive smoking, exclusive breast feeding, intercom use, and maternal age and education (table III). Maternal prenatal care did not substantially alter the odds ratio (daytime 1.39 (0.61 to 3.15), night 1.22 (0.60 to 2.50)).

When maternal alcohol and recreational drug use were independently added to the model the odds ratios for bed sharing during the day and night remained virtually unchanged. There were no interactive effects between bed sharing and passive smoking, alcohol, or recreational drugs.

## Discussion

There is great controversy about bed sharing and the sudden infant death syndrome. Our study confirmed that significantly more Latin American and African-American parents and infants than white families routinely slept together. For infants who died from the syndrome 45 deaths occurred while sharing a bed. There was a weak association between bed sharing and the sudden infant death syndrome (odds ratio 1.21 night, 1.38 day), which was not significant when potential confounders were adjusted for. In our study bed sharing was not a major risk factor for the syndrome. Sample size calculations indicate that 200 matched sets would require an odds ratio of 2.9 for a significance level of P < 0.05 and 80% power.

Five studies have reported that bed sharing, usually in combination with maternal smoking or alcohol consumption, was a risk factor for the sudden infant death syndrome.<sup>5-9</sup> We found no interactive effect between bed sharing and maternal use of alcohol, tobacco, or recreational drugs. In contrast, studies based solely on Asian populations reported lower rates of the syndrome with bed sharing.<sup>15-18</sup>

Unlike the aforementioned studies, our study accounted for routine bed sharing during the day and night. The comparison of routine bed sharing rather than sharing just at the time of death reduced the risk of confounding due to illness. Bed sharing at death was independently ascertained rather than using bed sharing over the last two weeks of life as a routine measure of bed sharing.<sup>7</sup> In previous studies control infants were absent<sup>8</sup> or poorly selected.<sup>9</sup> Most importantly, adjustment for salient maternal and infant characteristics was not performed in other studies.<sup>5,8,10</sup> We adjusted for confounders not dealt with previously,<sup>18</sup> including passive smoking, intercom use, maternal education, recreational drug use, and any neonatal medical conditions. Diagnoses of the sudden infant death syndrome differed between this study and that of Scragg *et al*, which included infants with abnormalities,<sup>7</sup> and Carpenter's, which included infants up to 2 years of age and had an 80% necropsy rate.<sup>5</sup> To our knowledge, although Scragg *et al* compared bed sharing among Maori and Pacific Islanders,<sup>7</sup> ours is the first study to examine it among four racial groups in the United States.

Recall bias may have been a problem in this study because the Human Subjects Committee required a delay before we interviewed case parents. A subsample (50%) of interviews with parents of infants who died was compared with reports from the scene of death, and the agreement rate was very high. In addition, 10 mothers and fathers from each group underwent separate interviews, resulting in a very high agreement rate for all infant characteristics and information at the scene of death. Furthermore, control infants may have been older than their corresponding cases when their parents were interviewed. Each control infant's age corresponded to the case infant's age for particular events including vaccinations, illnesses, and breast feeding practices. During the interview, the sleeping arrangement during infancy was always specified. Recall bias was minimised because bed sharing was not the primary hypothesis, a standardised interview was used for all parents, and great attention was devoted to the interview technique, including ordering of questions based on a time line corresponding with life events from pregnancy through birth.

Although bed sharing occurs in about 90% of the world population, western industrialised societies consider solitary infant sleep a normal and desirable arrangement.<sup>3</sup> In fact, infants are expected to exhibit adult sleep profiles by 3-4 months of age.<sup>19</sup> There are, however, potential benefits to bed sharing. Parents sleeping with their infants inadvertently provide stimulation through vocalisations, body move-

TABLE III—Unadjusted and adjusted odds ratios (95% confidence interval) for the sudden infant death syndrome associated with routine day and night bedsharing; southern California, 1989-92 (200 cases, 200 controls)

Detail	Odds ratio (95% confidence interval)
Unadjusted day	1.52 (0.92 to 2.52)
Unadjusted night	1.28 (0.81 to 2.03)
Adjusted day*	1.38 (0.59 to 3.22)
Adjusted night*	1.21 (0.59 to 2.48)

\*Adjusted for routine sleep position, passive smoking, breast feeding, use of intercom, maternal age and education, infant birth weight, and any medical conditions at birth.

### Key messages

- A total of 200 case and 200 control infants were compared for type of bed and sleeping arrangement (for example, alone or sharing a bed) during the day and night
- Bed sharing during the day was more common in African-American and Latin American families than white families
- Forty five (22.4%) deaths occurred in infants who were sharing a bed
- There was lack of evidence of an effect between bed sharing during the day and night and the sudden infant death syndrome
- Future larger studies should investigate unknown physiological or behavioural risk factors of bed sharing and the sudden infant death syndrome

ments, radiant heat, respiratory sounds, odours, and possibly expired gases.<sup>3</sup> Infants who share the parents' bed arise more frequently and simultaneously with the mother and spend less time in stage three to four of quiet sleep.<sup>3</sup>

Although the cause of the sudden infant death syndrome is multifactorial, contemporary hypotheses include defects in arousal or cardiorespiratory control.<sup>20</sup> If bed sharing were protective for the sudden infant death syndrome it might override potentially fatal breathing errors or decreasing arousal deficits.<sup>21</sup> In contrast, bed sharing may increase the risk of the syndrome through accidental suffocation by overlaying or hyperthermia.<sup>6</sup> In this study, there was little evidence of an effect of bed sharing on the syndrome. Additional prospective studies are required to determine whether other unknown physiological or behavioural risk factors associated with sharing a bed may increase the risk of the sudden infant death syndrome.

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## Style Matters

### Protection of patients' rights to privacy

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